

FURTHER NOTES ON THE HOLOCENE NON-MARINE SHELLS OF  
PERRANZABULOE, CORNWALL.

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IN continuation of my observations on the blown sand deposits of Perranzabuloe last November, I was able to pay a further visit to Cornwall last January.

These sands are divided into three districts—(1) the Reen Sands near Perranporth, (2) the Gear Sands towards the central area, and (3) the Penhale Sands to the north, near Cubert. The fluviatile (lacustrine) deposit occurs on the Gear Sands, from which the farmers are accustomed to draw their supplies of shell-sand for fertilizing purposes, evidently a well-recognized work, as there is a toll-house where they pay the dues to the owner of the sands for this privilege. This is interesting to us, since it is in the lacustrine area and its neighbourhood that the greater part of the sand-carting is done. Add to this the constant destruction of the now dessicated lacustrine area by the wind, as detailed in my last paper, and the wonder is, not that there is so little of this deposit left, but that there is any at all. I have found no further species to record. The finding of *Limnæas* at a higher level (about 8 feet) in the same superficial marly sand shows that the lake area was basin-shaped, and not merely a shallow flattish area.

After consultation with Mr. A. Santer Kennard, F.G.S., I find that the doubtful *Limnæas* may be ranged under *L. pereger* and *L. truncatula*, with the exception of a *Limnæa* which is probably a new species, being identical with a form occurring in Ireland which has been mis-called *L. auricularia*, var. *acuta*. The *Succineas* also are to be classed under *S. elegans*; a possible *oblonga* must be crossed out and omitted from the list.

Mr. Penrose accompanied me to the place, and promised to see whether the collection of the Royal Institution of Cornwall, which is under his charge as Curator, contained anything that would throw light on the question, but I have heard nothing further on the matter.

Mr. Kennard considers this find as of great importance. His remarks are as follows:—"I have been over your shells carefully, and a more remarkable lot of *Limnæas* I have never seen. I have compared them with my own collection, and that is a large one of fossil and recent *Limnæa pereger*, and there are many that I cannot match. One thing that strikes one is the great variation in *pereger*; some are dwarfed, others are large, nearly all are *very* thick. Some are fairly typical, but these gradually pass into the narrow, slender, compressed form. These latter are something like what is called on the Continent *L. succinea*, Nilsson, only the characters of that form are more pronounced in the Cornish shells. Now thick shells are found either in rapid waters or greatly disturbed waters, so that if there were a lake

then its surface would be agitated. I have cleaned out your shells and I find that in nearly all of them there was a marly matrix still remaining, not the material that one would find in a swamp or morass, but in a lake with a *CHARA* vegetation. A lake, moreover, to deposit such material must be of some depth, say 12 feet at least. Were it less than that marl would not form, it would be a carbonaceous mud. Since so many of the *L. pereger* are decidedly not normal there must have been abnormal conditions there. This raises the question in my mind whether the new Limnæas may not after all only be *auricularia*, which owing to unfavourable conditions were stunted during the latter period of their life, and so unable to properly develop the last whorl. I still think that these are the same as the Irish shells, a new form, but I have stated the alternative."

These remarks agree with the observed conditions, for the lacustrine area consists of a deposit of a marly nature, of a thickness of 2 or 3 inches, on the top of blown sand about 30 inches thick, the fresh-water shells occurring only in the upper 2 or 3 inches.

The lacustrine area of the Gear Sands is confined to the eastern side of the highest sand dunes. I could find no extension of it towards the Penhale Sands. Probably the underlying rocks render that impossible. At Penhale Sands there is a swampy area at a much lower level than the lacustrine area aforesaid, surrounded by lofty sand dunes. I should think the lower level here is not more than 80 or 90 feet O.D., compared with 200 feet for the lacustrine area. Above the swampy part, which, however, was dry when I was there in January last, and on the north of it, there are three terraces, apparently natural. On the upper terrace I found a valve of *Pecten varius*, bored by *Cliona perforans*, and on the two lower terraces valves and broken fragments of *Mytilus edulis* were abundant. I also found a fragment of another bivalve and a few *Patella vulgata* and a *Purpura lapillus*. The broken *Mytilus edulis*, etc., may be the debris of a kitchen midden, but some at least may have reached their present position by being rolled up the slopes of sand by the wild Atlantic gales, seeing that the slope to the seashore is in some places continuous from the beach upward and the blown sand completely masks the cliffs, if indeed they exist at these particular spots. In the swampy sand at about 125 feet O.D. a very few *Limnæa pereger* occurred.

In conclusion I have to thank my friend Mr. A. Santer Kennard for the kind trouble which he has taken to work out the puzzling lacustrine specimens.

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